System integration of the Silicon Tracking System for the CBM experiment at FAIR

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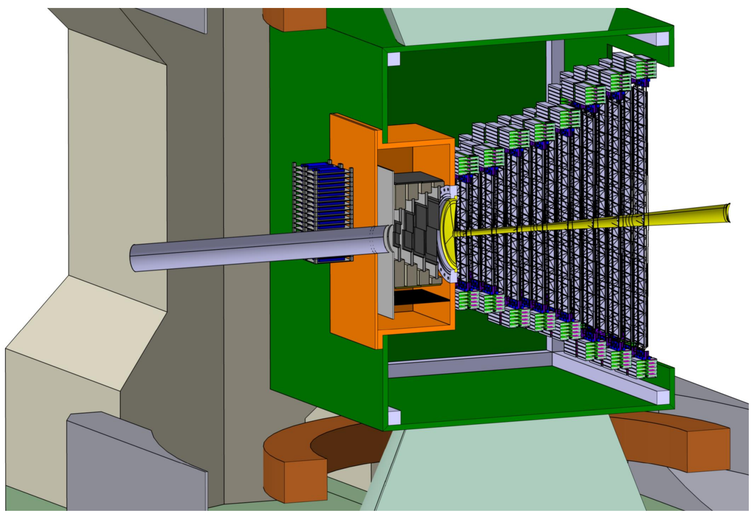
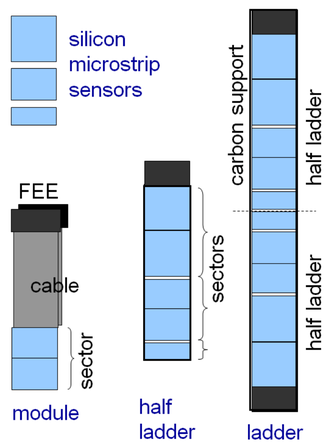
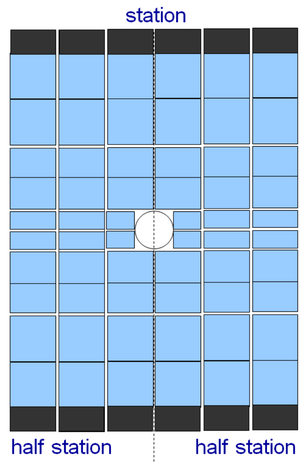
System concept



- **STS** is the central tracking detector in CBM
  - 8 tracking stations
  - ~4 m² active area
- **Integration, operation, maintenance**
  - confined space in the dipole magnet
  - 2 m³ of volume
  - module assembly and attachment
  - ladder construction and attachment
  - cooling of the sensors (-5 °C)
  - cooling of the front-end electronics
  - power dissipation: 40 kW (two thin layers)



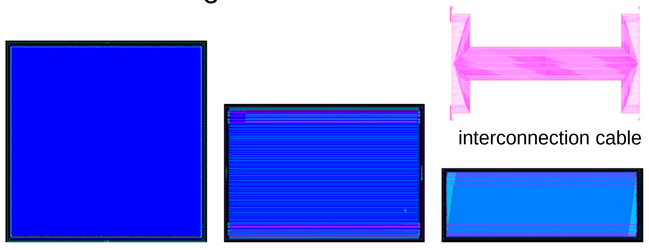


Components	
Ladders	106
Modules	896
Sensors	1220
Cables	14336
Cable lengths	15 cm – 60 cm
r/o chips	14336
channels	1835k

Components

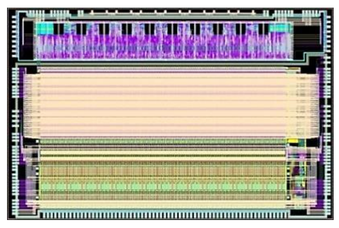
Double-sided silicon sensors

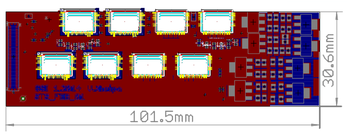
- 1024 channels (58 µm strip pitch)
- 300 µm thickness
- strip lengths 2, 4, 6 and 12 cm
- stereo-angle 7.5°



Self-triggered front-end electronics

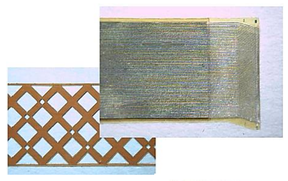
- STS-XYTER
- 128 channels (8 per side)
- two rows for bonding
- power dissipation < 5mW/channel





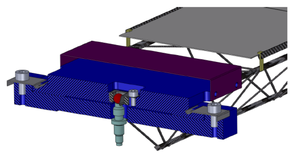
Low-mass micro cables

- 128 channels (8 per side)
- two layers, tap bonding

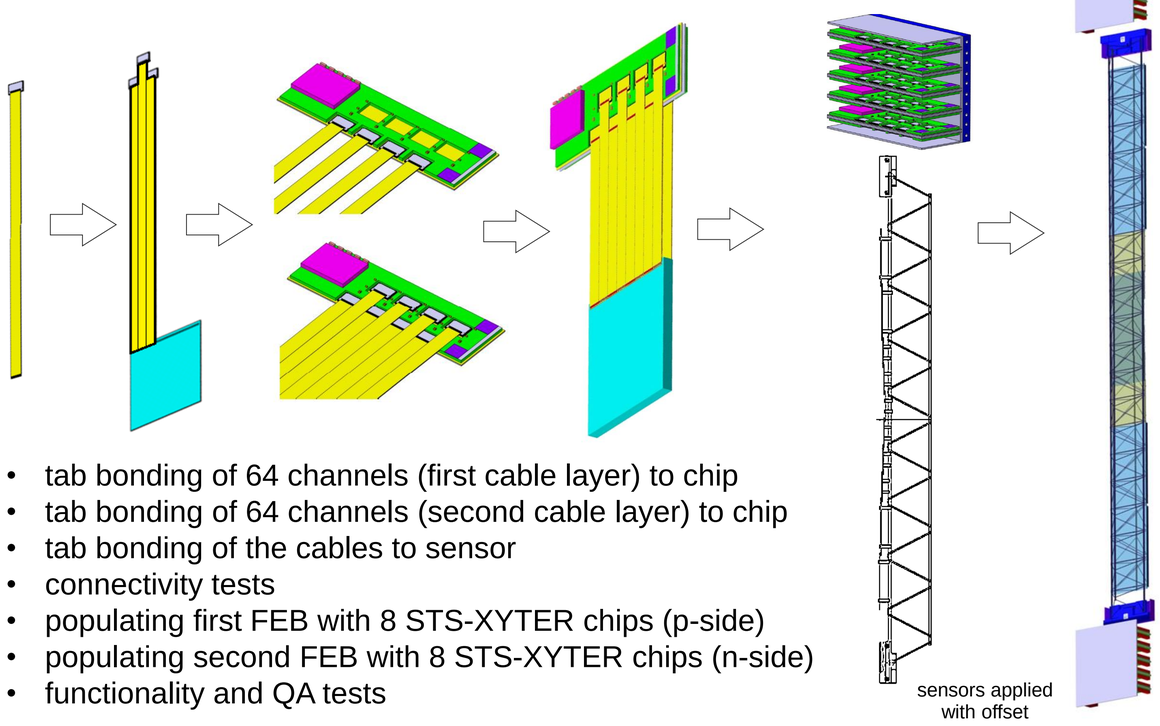


Ladders

- lightweight carbon-fiber space frames with end supports
- ladder comprises two times five modules
- one-cycle polymerization at 125 °C in a metallic mold
- modules are attached using legs

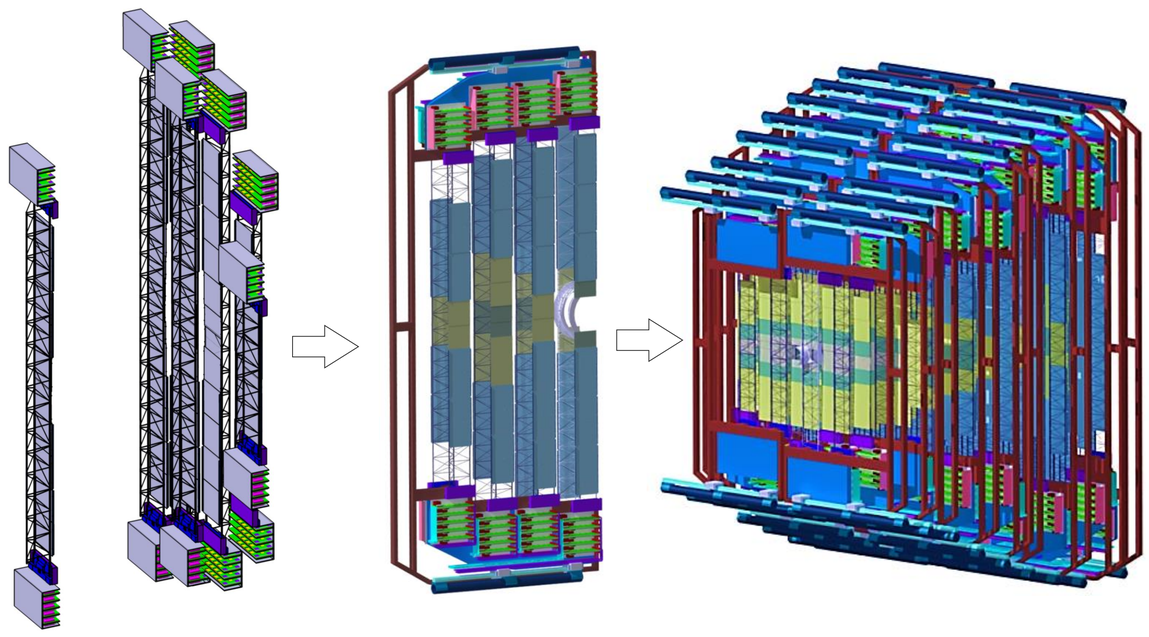


Module and ladder assembly



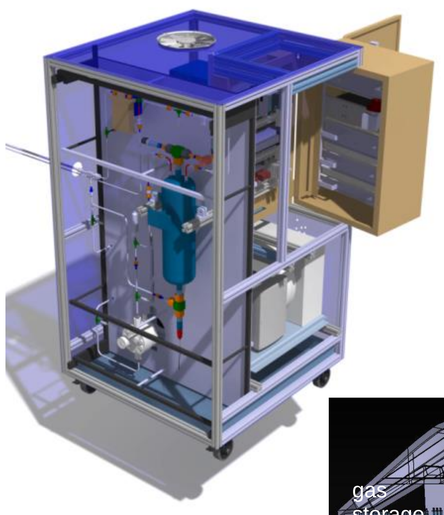
- tab bonding of 64 channels (first cable layer) to chip
- tab bonding of 64 channels (second cable layer) to chip
- tab bonding of the cables to sensor
- connectivity tests
- populating first FEB with 8 STS-XYTER chips (p-side)
- populating second FEB with 8 STS-XYTER chips (n-side)
- functionality and QA tests

System integration

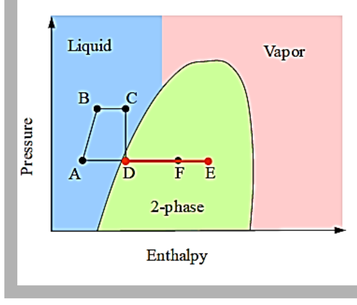


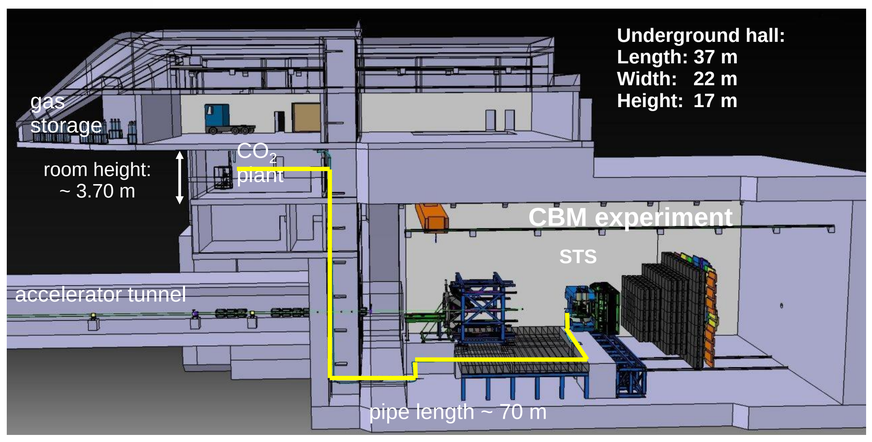
Ladders — Unit — System with 8 stations

Cooling system



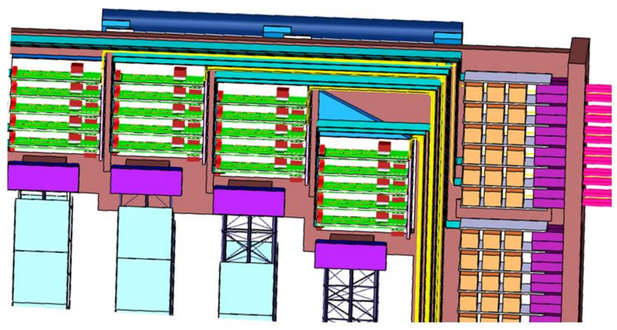
- STS read-out electronics dissipates ca. 40 kW (212 FEE blocks of 200 W)
- cooling with bi-phase CO_2 **(2-phase accumulator controlled loop)**
  - high efficiency at small spatial requirement
- standard for tracker upgrades at LHC
- cooperation of GSI with CERN: **TRACI-XL**





Cables routing

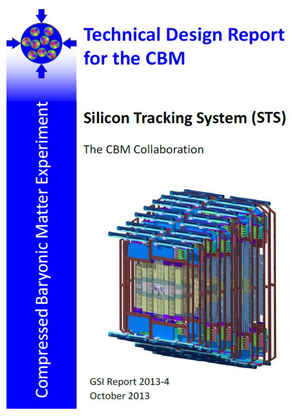
Mockup



Technical Design Report

available at:

http://repository.gsi.de/record/54798



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